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(56) Documents cited
GB 1576187
GB 1294794
GB 0951132
GB 0917074
GB 0814701
GB 0800801
GB 0355000
GB 0298853
(58) Field of search **D2A**

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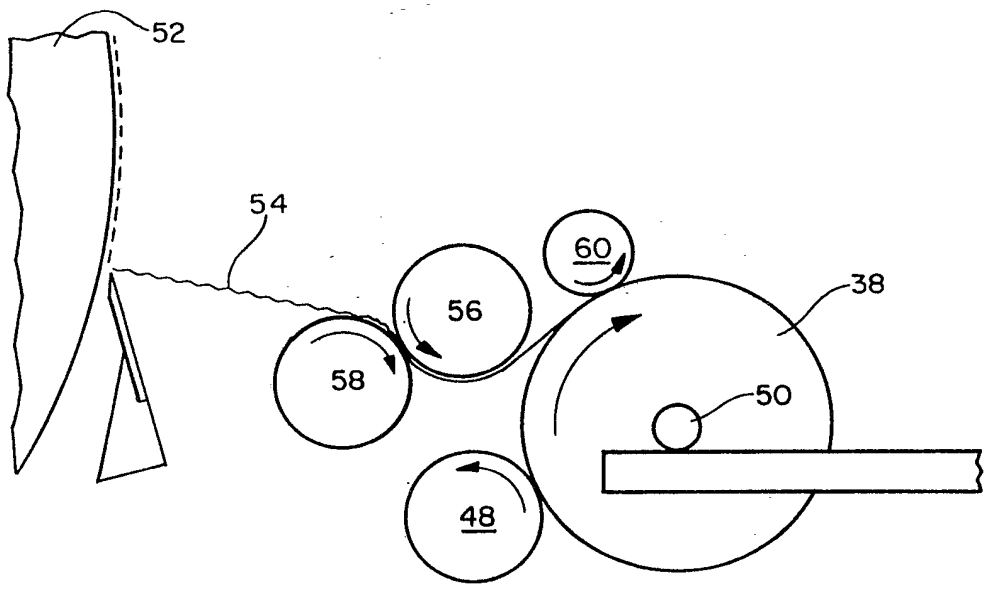
(54) Calendering of creped tissue products

(57) In a method and apparatus for calendering a creped web (52) in close proximity to a reel spool (56) and taking up resulting growth of the web, the reel spool (50) is rotated faster than calender rolls (56, 58) or creping cylinder (52), and an open draw is provided between the calender rolls (56, 58) and the reel spool 50. A straight-through threading path (Figure 6, not shown) from the creping cylinder (52) to the reel spool (50) is provided by retracting one of the calender rolls (58) and a rider roll (60) adjacent to the roll (38).

FIG. 4



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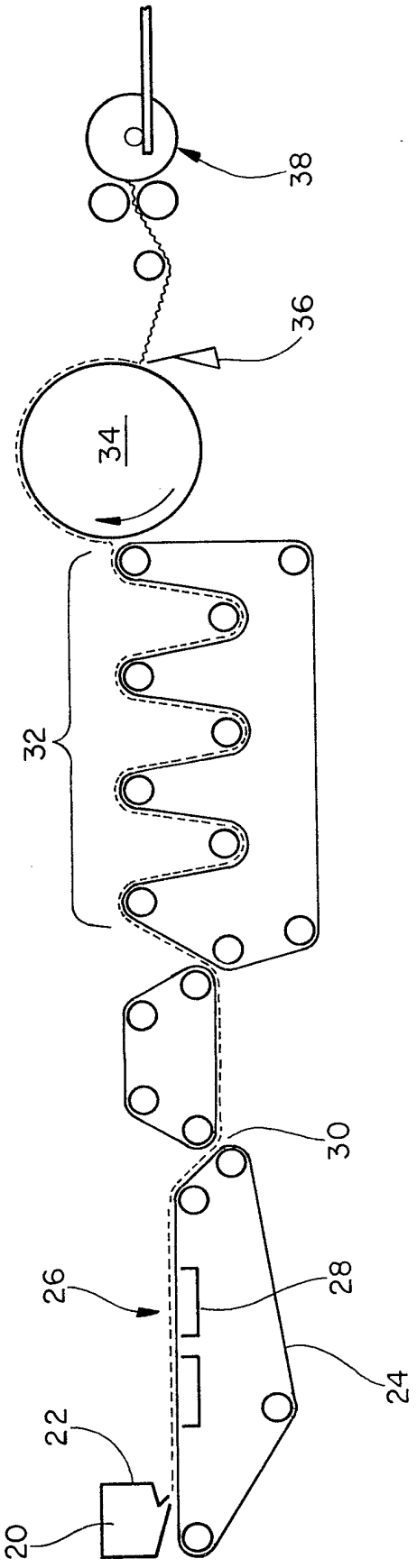

FIG. 1

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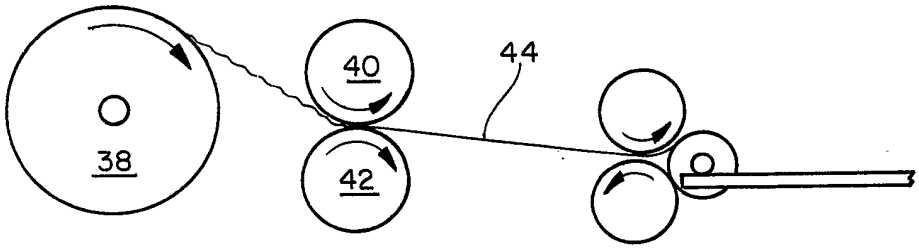

FIG. 2

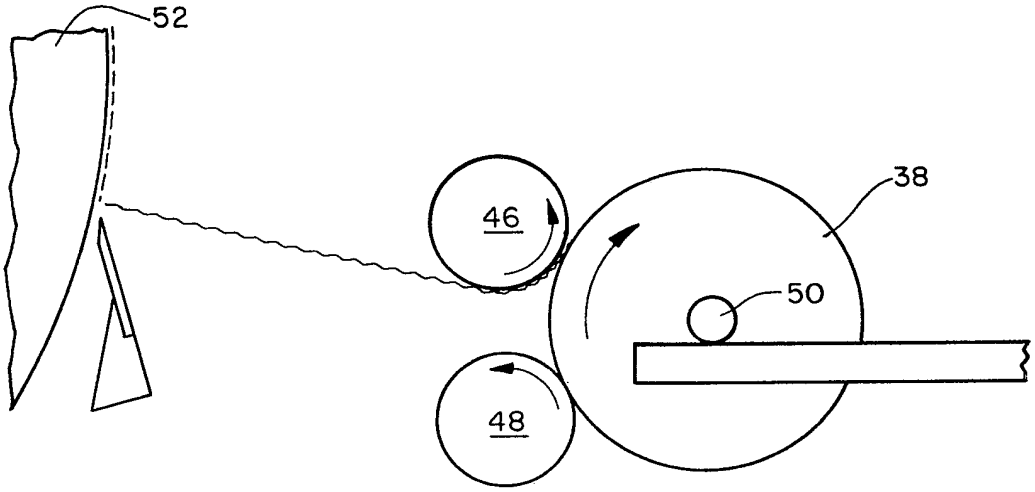

FIG. 3

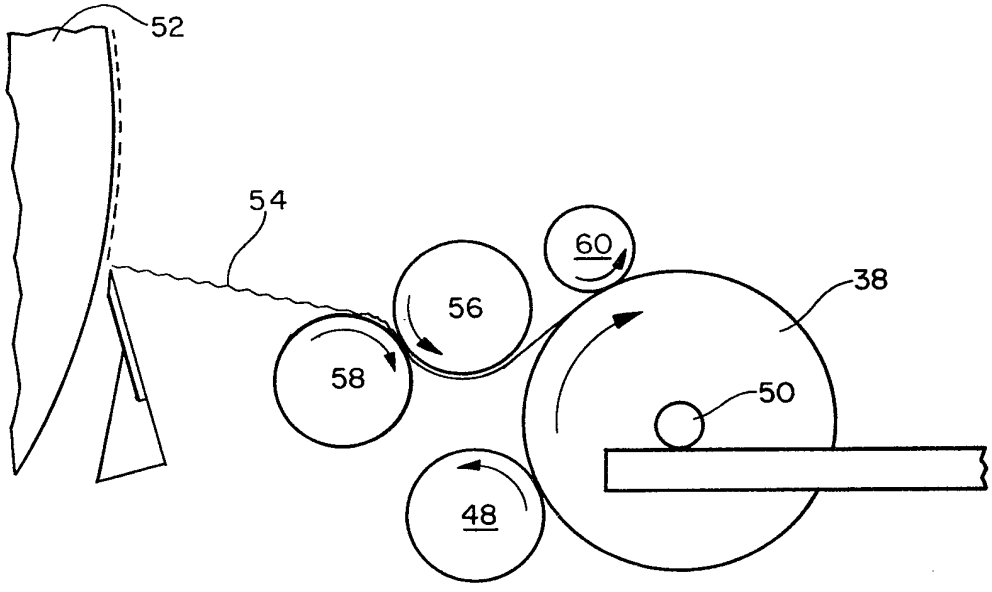

FIG. 4

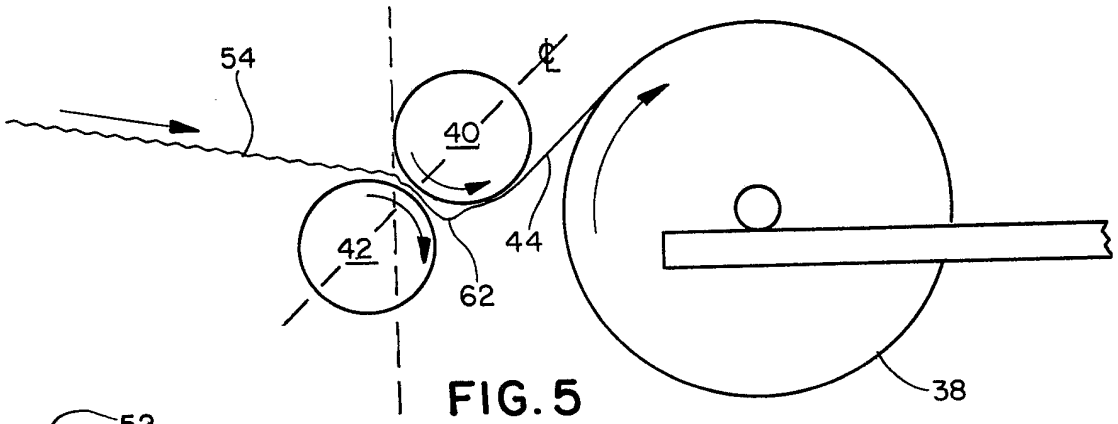

FIG. 5

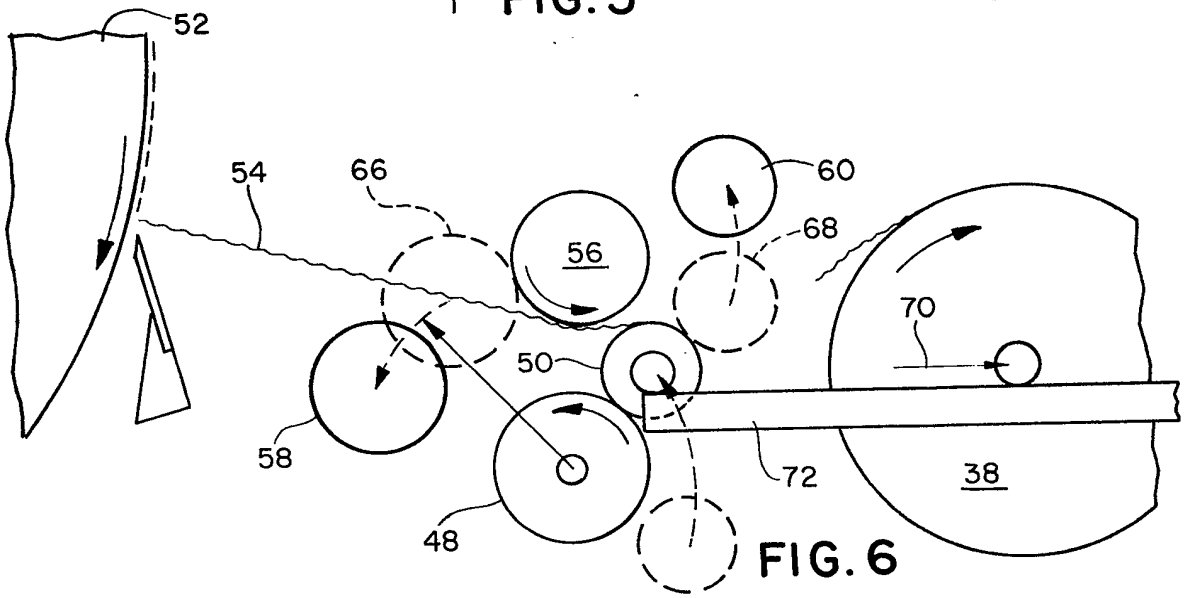

FIG. 6

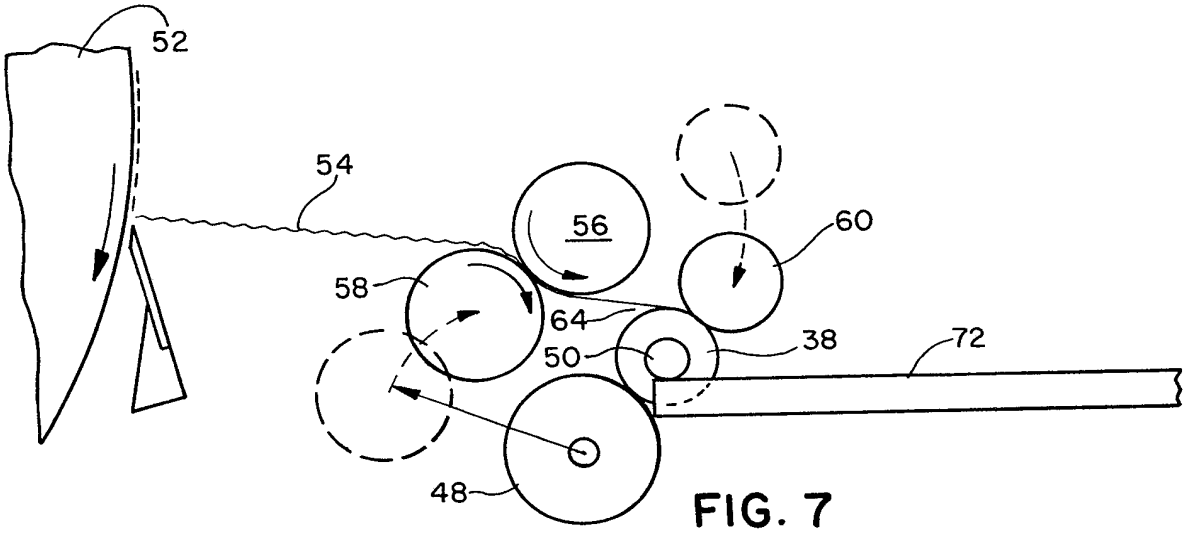

FIG. 7

SPECIFICATION

Improvements in or relating to the calendering of creped tissue products

The calendering of creped tissue products is well known in the art of papermaking, and has traditionally taken place after the web of creped product has been reeled up into a so-called "soft" roll. The soft roll is usually calendered when it is rewound into a hard roll or converted into consumer products such as tissues, towels, etc.

It is also well known in the art to reel up the creped web into a "soft" roll on a reel spool which is driven by a reel drum, the reel drum being the final rotating element in the sheet manufacturing process. This single-drum reel is the primary component of either the traditional "Pope reel" or the "Level-rail" reel. In either case the function of the reel drum is similar. An alternative method of reeling utilizes two reel drums oriented vertically adjacent the soft roll with the reel spool supported on a level rail. This system, complete with insertion of a new reel spool "on-the-fly" (i.e. without stopping the machine) is also well known in the arts.

It has been proposed to combine this vertically-oriented, two-drum reel with a calender roll and rider roll to, in effect, develop a close-coupled calender and reel which will consume minimal space, allow easy threading and be adaptable to either existing machine configuration or new configurations.

By calendering the creped web in-line, as opposed to a calender after a period of storage, the temperature of the web is higher (on the order of 150°F) and it is believed that less nip pressure between the calender roll and the soft roll will be required to attain an acceptable surface finish than is required with a relatively cooler web (room temperature) as is in the traditional rewinding operation. It is also believed that since the vertical reel drum orientation allows straight-through threading of the web, "swing-ups" (bringing a new reel spool into position for the rolling up of a new soft roll) will be easier to accomplish and efficiency of transfers will be maintained or improved.

However, the calendering of a creped web necessarily results in an "extrusion phenomena". That is, when the corrugated creped web is compressed between the calender rolls, a minute amount of unit elongation occurs which is greatly magnified on a web having a linear speed of over 4,000 feet per minute. The effect is to produce a "bubble" at the outgoing end of the calender press nip which must be taken up by the "soft roll" on the reel spool. If the rotational surface velocity of the "soft roll" does not exceed the lineal speed of the web exiting the calender rolls, the bubble will enlarge and eventually lead to a machine shutdown. Therefore it is suggested in U.S. Patent No. 4,179,330, Page, that by "splitting the torque" between the reel drum/calender roll and the reel core, this extrusion phenomena will be eliminated. It is also suggested that the web flutter between the creping cylinder and the calender roll may be suppressed by providing foils above the web for substantially the entire length of the open draw to suppress extraneous air currents.

Viewed from one aspect the invention provides an apparatus for calendering and reeling a creped tissue product from a creping cyclinder, comprising a pair of calender rolls, one of which is movable from an operative to an inoperative position, and a driven reel spool, the calender rolls being adjacent the reel spool and the arrangement being such that in use there is an open draw between the calender rolls and the reel spool.

Viewed from a second aspect the invention provides a method of calendering a tissue product creped from a creping cylinder and winding said tissue product onto a driven reel spool comprising the steps of calendering said product between a pair of calender rolls, one of which is movable, said rolls being adjacent said reel spool, providing an open draw from said calender rolls to said reel spool and rotating said reel spool at a rotational surface velocity greater than the rotational surface velocity of said creping cylinder and said calender rolls such that when said creped tissue product undergoes elongation resulting from the action of said calender rolls, said elongation is taken up by said reel spool across said open draw.

Thus in a preferred embodiment, a tissue web creped from a creping cylinder is wound upon a reel spool, with the web being calendered between a pair of calender rolls which are interposed between the creping cylinder and the reel spool. A reel drum assists a driven reel spool in winding up the creped calendered web. One of the calender rolls and a rider roll may be moved from operative positions to inoperative positions so that the creped web may be threaded onto a new reel spool in a straight line. The calender rolls are positioned such that an open draw is provided between the calender rolls and the reel spool, so that, as the web undergoes "nip extrusion", or elongation, upon exiting the calender nip, the elongation may be taken up in the open draw by the reel spool, which has a greater surface velocity than the surface velocity of the calender rolls or creping cylinder. The reel spool may be provided with vacuum means therein to assist in the pick-up of the creped web onto the new reel spool.

Brief Description of the Drawings

FIG. 1 is a schematic view of a conventional papermaking machine producing creped tissue product;

FIG. 2 is a schematic representation of the calendering of a creped tissue web;

FIG. 3 is a schematic representation of a vertically oriented two-drum reeling system;

FIG. 4 is a schematic representation of a close-coupled reeling and calendering apparatus;

FIG. 5 is an exaggerated view of a creped web being calendered;

FIG. 6 is a schematic representation of a calender roll and rider roll in the retracted position, and

FIG. 7 is a schematic representation of a view similar to FIG. 6 with the rolls in the operational position.

Description of the Preferred Embodiment

As shown in FIG. 1, creped paper as used in disposable tissue or toweling, is traditionally made by a wet-laid process, whereby a slurry 20 comprising predominantly water and cellulosic fibers is deposited from a headbox 22 located above a foraminous forming wire 24. The web thus formed, generally designated 26, may be subjected to one or more of a number of drying procedures, including vacuum boxes 28, felted press section 30, heated can dryers 32, and a Yankee Dryer 34. The web is creped from the Yankee Dryer 34 by doctor blade 36 and reeled into a "soft roll" 38 of creped tissue product.

Traditionally the "soft roll" 38 as shown in FIG. 2 is run through the rewinder, usually located in the web manufacturing area, to make a denser "hard roll" which can then be taken directly to a converting area for processing into individual units of tissue or towel products or it can be temporarily stored for later conversion into finished products. The rewinder traditionally has one or more calender units or stations composed of mated rolls 40 & 42 which under nip pressure, uniformly debulk the web and improve the surface texture.

It has been suggested to combine the functions of one of the reel drums with the calender rolls, such that the reel drum will nip a second calender roll as well as the soft roll, thereby calendering the creped product as well as assisting the reeling-up of the product. U.S Patent No. 4,179,330, referred to above, discloses a method of combining the reeling and calendering function into a single roll.

As shown in FIG. 3, Applicant's "vertically oriented reel drums" 46, 48 are located adjacent the soft roll 38 as it is wound upon reel spool 50. The reel drums 46, 48 assist in the winding-up of the creped product onto the reel spool 50, which may itself be driven by appropriate power means (not shown). Reel drums 46, 48 may be located directly beneath the soft roll 38, but applicant has determined that the vertically oriented reel drums permit lower cost reeling by requiring less space and shorter draws, with improved product attributes. It has been proposed to calender the creped web directly in-line between the creping cylinder 52 and the soft roll 38. However, most paper machines are housed within buildings constructed to permit the reeling of a soft roll from the machine which will be transported to an adjacent location for calendering and conversion. Therefore, the addition of a calender stack as shown in FIG. 2 within a conventional papermaking machine would require additional space which in many instances may not be available. Therefore, the present invention is proposed to permit in-line calendering without requiring additional space, and with minimal capital investments. As shown in FIG. 4, a creped web 54 is creped from creping cylinder 52 and calendered in-line prior to being reeled onto reel spool 50. As illustrated in FIG. 4, one of the vertically oriented reel drums common in Applicant's papermaking process is replaced by a calender roll. In this embodiment, a stationary calender roll 56 (occupying the position generally equivalent to reel drum 46 at FIG. 3) nips with movable calender roll 58 adjacent soft roll 38. Reel drum 48 is unchanged, and its frictional engagement with soft roll 38 assists in the winding up of the creped product. Because the reel drum 46 has been replaced by calender roll 56, additional winding capacity may be necessary, therefore rider roll 60 is provided to assist in the winding up of soft roll 38.

As discussed above, and as shown more specifically in FIG. 5, creped products 54 having a corrugate-like cross-sectional configuration are passed between calender rolls 40, 42, and what applicant refers to as "nip-extrusion" occurs. In the process of calendering, a given unit of the uncalendered web 54 is elongated due to the flattening-out or compression of the corrugated ridges so that a "bubble" 62 is formed on the trailing edge of the nip in calendered web 44. It is to be understood that the bubble 62 illustrated in FIG. 5 is greatly enlarged, and that under normal operating conditions, the bubble will be extremely small relative to the size of calender rolls 40, 42 and will be located between the calender rolls as the web 44 exits the nip. If the creping cylinder, the calender rolls and the soft roll are all run at the same speed, the bubble 62 will enlarge and, with a creped web having a lineal speed in excess of 4,000 feet per minute, will become unmanageable in a very short period of time, and lead to machine shutdown. Therefore, the soft roll 38 must have a surface rotational speed greater than the linear speed of the web entering the nip between calender rolls 40, 42 in order to absorb the elongation of the web exiting the calender roll nip. Applicant has found that, if the web 54 has a speed of approximately 4,000—4,500 feet per minute, the soft roll must be rotated only on the order of 10—20 feet per minute faster in order to absorb the excess web length caused by nip extrusion.

In order to run the soft roll with a greater surface rotational velocity than the rotational velocity of the calender rolls, there is preferably an open draw between the calender rolls and the soft roll. Therefore, if a calender roll 56 is substituted for a reel drum as shown in FIG. 4, the calender roll must be positioned such that an open draw designated 64, is located between the calender roll 56 and soft roll 38. Without an open draw, the calender roll 56 and soft roll 38 would be in frictional engagement, so that with the soft roll 38 moving at a greater speed than calender roll 56 (in order to take up the nip extrusion), extreme friction will be generated and the energy requirement of the motors driving the soft roll and calender roll will be greatly increased. Additionally, the differential speed between the calender and soft roll may lead to web breakage or damage at the nip therebetween. The open draw 64 between the

calender rolls and the soft roll need only be a matter of an inch or more, but at least as large as the bubble that is formed at the exit end of the nip between calender rolls 56 and 58.

As shown in FIG. 6, calender roll 58 and rider roll 60 are movable from operating positions (shown in dashed lines) 66 and 68 respectively, to inoperative positions permitting the straight-through threading of the creped web 54. Applicant has found that the process of threading the web onto the reel spool 50 is facilitated when the calender roll and rider roll are retracted from their operative position. Threading may occur at any time after the machine has been shut down, the web has broken, or, as is the usual case, when a new reel spool is threaded on the run.

When a soft roll is fully loaded with creped product, it may be removed outwardly in the direction of arrow 70 along guide rails 72, and a new reel spool 50 moved into position adjacent reel drum 48. With the rider roll 60 in the retracted position of FIG. 6, the new spool 50 picks up the creped product with vacuum assist (not shown) and begins reeling the product thereon. As shown in FIG. 7, the calender roll 58 and rider roll 60 are moved into their operative positions, so that the creped product is calendered and reeled onto reel spool 50. As the reel spool accumulates more product thereon and the diameter increases, it moves outwardly along rail 72 and the rider roll 60 is biased upwardly to remain in contact with the surface of soft roll 38. As illustrated in FIG. 7, creped product from creping cylinder 52 is calendered between rolls 56, 58 and the bubble resulting from nip extrusion is taken up through the open draw 64 by the reel spool 50 which is revolving at a somewhat greater speed than the calender rolls and creping cylinder. When the new reel spool is full, the process of FIGS. 6 and 7 is again repeated.

CLAIMS

1. Apparatus for calendering and reeling a creped tissue product from a creping cylinder, comprising a pair of calender rolls, one of which is movable from an operative to an inoperative position, and a driven reel spool, the calender rolls being adjacent the reel spool and the arrangement being such that in use there is an open draw between the calender rolls and the reel spool.

2. Apparatus as claimed in claim 1 wherein said reel spool is arranged to be driven at a surface rotational velocity greater than the surface rotational velocity of said creping cylinder and said calender rolls.

3. Apparatus as claimed in claim 1 or 2 wherein a reel drum is provided to assist in winding said tissue product onto said reel spool.

4. Apparatus as claimed in claim 3 wherein a movable rider roll is provided to assist said reel drum in winding said tissue product onto said reel spool.

5. Apparatus as claimed in claim 4 wherein said rider roll is adapted to be retracted from a nipped engagement with the product on said reel spool when a full roll of tissue product is replaced by an empty reel spool.

6. Apparatus as claimed in any preceding claim wherein said reel spool is provided with vacuum means to direct said tissue product onto said reel spool when empty.

7. Apparatus as claimed in any preceding claim wherein said movable calender roll is adapted to be retracted to a position which permits said tissue product to follow a straight path from said creping cylinder to said reel spool when said reel spool is initially threaded.

8. A method of calendering a tissue product creped from a creping cylinder and winding said tissue product onto a driven reel spool comprising the steps of calendering said product between a pair of calender rolls, one of which is movable, said rolls being adjacent said reel spool, providing an open draw from said calender rolls to said reel spool and rotating said reel spool at a rotational surface velocity greater than the rotational surface velocity of said creping cylinder and said calender rolls, such that when said creped tissue product undergoes elongation resulting from the action of said calender rolls, said elongation is taken up by said reel spool across said open draw.

9. A method as claimed in claim 8, further comprising retracting said movable calender roll from an operative position to an inoperative position when said reel spool is initially threaded.

10. A method as claimed in claim 9, further comprising retracting said movable calender roll to a position permitting straight through threading of said tissue product from said creping cylinder on to said reel spool.

11. A method as claimed in claim 8, 9 or 10, further comprising assisting the reeling up of the product onto said reel spool with a movable rider roll, said rider roll being nipped against the product on said reel spool.

12. A method as claimed in claim 11, further comprising retracting said rider roll to an inoperative position when a loaded reel spool is retracted and replaced with a new reel spool, and nipping said rider roll to said reel spool to assist the winding of product thereon.

13. A method as claimed in any of claims 8 to 12 further comprising assisting the winding of the tissue product onto said reel spool by means of a reel drum.

14. A method as claimed in any of claims 8 to 13, further comprising assisting the pickup of product onto a new reel spool by providing said reel spool with vacuum means therein.

15. Apparatus for calendering and reeling a creped tissue product substantially as hereinbefore described with reference to Figures

4, 6 and 7 of the accompanying drawings.

16. A method of calendering and reeling a creped tissue product substantially as hereinbefore described with reference to Figures 4, 6 and 7 of the accompanying drawings.

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